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Apical Papillae on the Hemipenes of Two Colubrid Snakes

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Edward D. Cope first proposed the use of characters of the reptilian hemipenis for taxonomic work in his "Prodromus of a new system of nonvenomous snakes" (1893). In this paper he mentioned four species of snakes, *Oligodon subquadratus*, *Cynophis helenae*, *Tropidoclonium lineatum*, and *Ceratophallus vittatus*, that had rigid papillae or an awn at the apex of the hemipenis. The hemipenis was figured for these species in Cope's later works (1895, 1900), and the terminal appendages appeared to be of two distinct types. *Oligodon*, *Tropidoclonium*, and *Ceratophallus* had a pair of rounded papillae, while *Cynophis* had a single, spiral pointed structure.

I have recently had the opportunity of examining the hemipenes of *Tropidoclonium* (= *Tropidoclonion*) *lineatum* and *Cynophis* (= *Elaphe*) *helenae*. Cope's descriptions are found to be essentially correct in one case, but quite erroneous in the other.

Tropidoclonion lineatum Hallowell

The hemipenis of this snake is of particular interest, because the status of the monotypic genus *Tropidoclonion* Cope (1860) has been questioned repeatedly. Superficially *Tropidoclonion* is much like *Thamnophis* Fitzinger (1843). Dunn (1932) evaluated the various features on which *Tropidoclonion* was based and stated (p. 196), "I . . . suggest that the snake in question be known henceforth as *Thamnophis*

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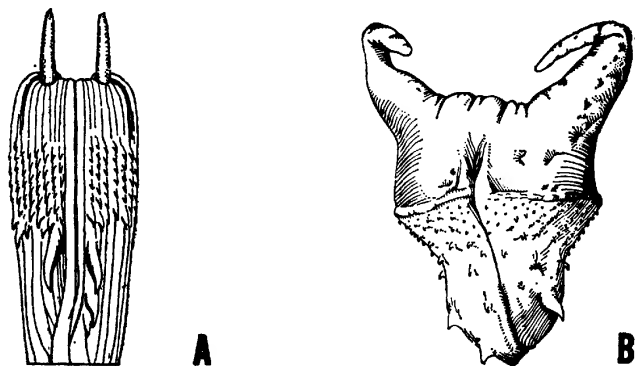


FIG. 1. Hemipenis of *Tropidoclonion lineatum* Hallowell. A. "*Tropidoclonium lineatum* Hallow., Texas. $\times 4$," as figured by Cope (1895, pl. 22, fig. 12) from an inverted specimen that had been split along the median line and spread flat. B. Drawing of the right hemipenis, everted, from a specimen in the Dowling collection.

lineatus." This was opposed by other workers, however, as "the monotypic form is obviously more different from any species of *Thamnophis* than any of the species in that genus are from one another" (Stejneger and Barbour, 1933, p. vi). Actually only the unusual ornamentation of the hemipenis would lead to such a decision.

Recently Dr. Albert P. Blair sent a series of these snakes to me alive, and I had the opportunity of preparing some of the hemipenes as everted specimens. I am able to corroborate Cope's observation of the apical papillae, but in the everted organ (fig. 1B) the papillae appear considerably different from those of the dissected organ figured by Cope (fig. 1A). It may be seen also that the "longitudinally plicate" area shown near the distal end of Cope's figure is actually an unornamented region that expands greatly; the "plicae" are merely folds.

DESCRIPTION OF HEMIPENIS: The hemipenis of *Tropidoclonion* is a single, non-capitate organ with a length of about 12 subcaudals (to the base of the papillae). It is somewhat bilobed distally and has the lateral edges of the lobes extended into long papillae. The sulcus is single and extends directly from the proximal towards the distal end between the lobes, but does not reach the apex. Its lips are neither raised nor especially ornamented. The proximal half of the organ is ornamented with spines: about four large spines basally and numerous rows of much smaller spinules towards the distal end. There is a distinct line of demarcation between this spinose area and the bare distal half, which is unornamented except for the two lateral papillae.

The hemipenis of *Tropidoclonion*, therefore, is "natricine" in its basic features: the presence of a single sulcus and ornamented with spines without calyces. Nevertheless, it differs from that of all other known American genera in the possession of a pair of elongate apical papillae. Although these papillae appear to be merely hollow extensions of the lobes found in many species of *Natrix* and *Thamnophis*, no other American snake is known to approach the state shown by *Tropidoclonion*. Its present status as a monotypic genus would seem to be assured until some such indication of relationship with other species is found.

It is of considerable interest, therefore, that Cope, in his original work on hemipenes (1893, p. 483), established a new genus, *Ceratophallus*, for the Oriental natricine, *Tropidonotus* (= *Natrix*) *vittatus* Linnaeus, "on account of the presence of a rigid papilla on the apex of each branch of the hemipenis." While no close relationship of *Tropidoclonion* with this species is suggested here, as *N. vittatus* has a divided hemipenis with forked sulcus (*vide* Cope, 1895, pl. 23, fig. 11), it is notable that at least one other "natricine" snake possesses the apical papillae.

Elaphe helena Daudin

Cope pointed out the presence of an apical papilla on the hemipenis of "*Cynophis*" in his first paper on the characteristics of the hemipenes (1893, p. 481). The figure published later (1895, pl. 16, fig. 6) shows an extraordinary, single, spiral awn of a type not otherwise described among reptiles (fig. 2A). However, he stated (1895, pp. 202-203), "In *Cynophis* I have found a remarkable apical awn, but as I have had the opportunity of examining but one individual, I am not sure how constant it is." Nevertheless, he used this character as an important feature in his synopsis of genera (1895, p. 205).

Malcolm Smith (1943, p. 149) described the hemipenis of *Elaphe helena*, as he did for the other Indian snakes. His omission of any reference to an apical structure might be taken to indicate its absence. However, he did not refer to Cope's work, nor did he figure the hemipenis of this species. Thus the question as to the constancy of this character has remained open from the time that Cope first proposed it.

A recent visit to the United States National Museum has allowed me to examine the hemipenes of a specimen from Ceylon (U.S.N.M. No. 129738) in that collection.

DESCRIPTION OF HEMIPENIS: The hemipenis of *Elaphe helena* is a single, non-capitate organ that is 25 subcaudals in length and possesses

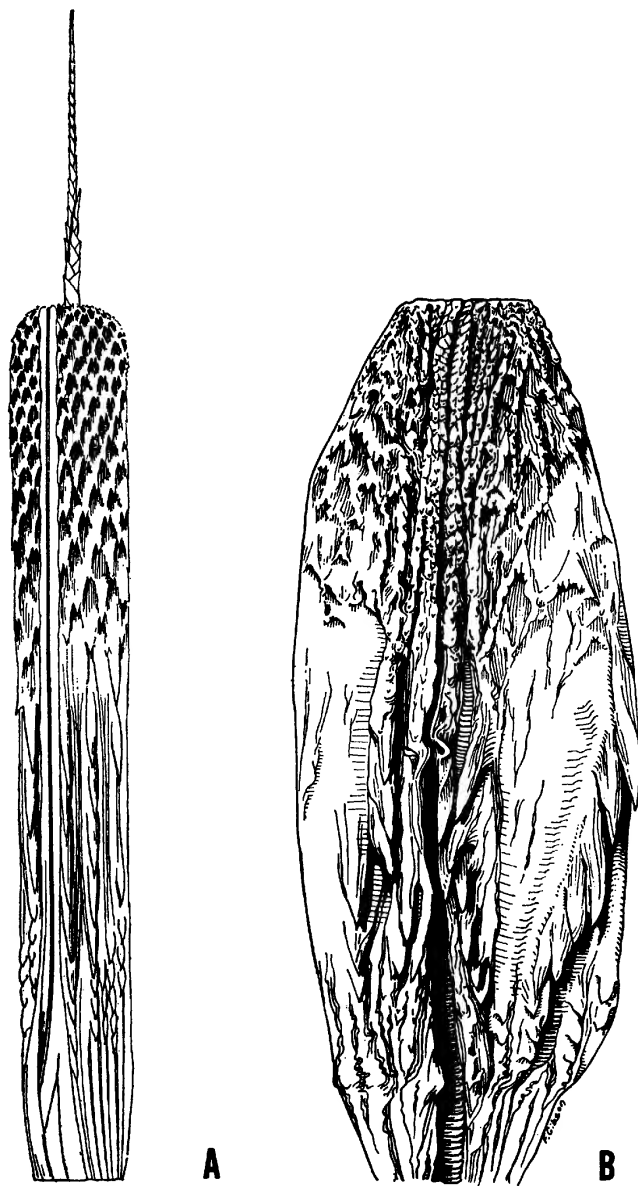


FIG. 2. Hemipenis of *Elaphe helenae* Daudin. A. "*Cynopsis helenae* Daud., Ceylon. $\times 3$," as figured by Cope (1895, pl. 16, fig. 6) from an inverted specimen that had been split along the median line and spread flat (slightly reduced). B. Drawing of the right hemipenis of U.S.N.M. No. 129738, which was prepared in the same fashion.

a single sulcus (fig. 2B). The proximal two-thirds of the organ is unornamented, except for three rows of elongate spines that degenerate into irregular groups of smaller spines near the base. One of the spinous rows lies along the sulcus on each side; the third row is on the side opposite the sulcus. At the level of subcaudal XIV these spines are abruptly replaced by minute spinules that are connected in one direction by membranous folds that extend distally and away from the sulcus in a roughly pinnate fashion. Much lower and less distinct folds connect the spinules in the other direction to form large and poorly differentiated calyces that extend to the distal end of the organ. The lips of the sulcus are unornamented proximally, but are beset with numerous spinulose papillae distally. There is no apical awn or structure of any kind. As this description (as well as Cope's) is taken from an inverted hemipenis that has been split and spread out, no precise description of the shape can be made. However, the absence of extensive folding in the distal portion suggests that there are no distal lobes.

These observations suggest that Cope unintentionally included a strand of the retractor muscle or some other artifact in the published figure and that a spiral apical awn does not exist on the hemipenis of *Elaphe helena* or that of any other known reptile.

Nevertheless, the hemipenis of *Elaphe helena* does differ to a considerable degree from that of the genotype, *Elaphe quatuorlineata* Lacépède, and that of the American and European species currently allocated to that genus (*vide* Dowling, 1958, p. 36, pl. 1). It also differs in having an entire anal plate rather than the divided one characteristic of Nearctic and Palearctic species. However, its dorsal scales are reduced as:

$$\begin{array}{rcc} 6+7 & 5+6 & 4+5 \\ 25 \frac{\quad}{6+7} & 23 \frac{\quad}{5+6} & 21 \frac{\quad}{4+5} 19 \end{array}$$

and thus show the midlateral mode of reduction possessed by other species currently allocated to *Elaphe*.

Because the amount of interspecific variation is still unknown in those characters in which it differs from the genotype, and its known characteristics do not suggest allocation to any other presently recognized genus, it seems preferable to retain *helena* within the genus *Elaphe* for the present. At some future time, when the interspecific and intergeneric variation of the hemipenial and scutellational characters is known and when other morphological features may be taken into consideration, some different decision may be necessary. Certainly it

differs from most of the species of *Elaphe* in numerous ways. With no more information than is presently available, however, a change in its generic status would do no more than to substitute one indefinite situation for another.

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The original drawings of the hemipenes were made by Frances W. Gibson, of the Department of Zoology, University of Arkansas.

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